HEMIPTERA AND COPEOGNATHA FROM THE UPPER PERMIAN OF NEW SOUTH WALES.

By Consett Davis, M.Sc., Lecturer in Biology, New England University College, Armidale.

(Twenty-four Text-figures.)

[Read 20th May, 1942.]

Introduction.

A very interesting collection of fossil Hemiptera and Copeognatha was received for study from Mr. Malcolm S. Stanley, of Beecroft, who obtained them in Upper Permian tuffs at Warner's Bay, Lake Macquarie, N.S.W. My thanks are due to him both for the opportunity of studying this collection, and also for permission to place type and other important specimens in the Australian Museum.

All figures in this paper were prepared with a camera lucida, lighting being adjusted as necessary to throw up the venation in relief. No attempt has been made to indicate the convexity or concavity of veins; in some cases, easily-identifiable pairs of veins of opposite sign (e.g., Sc and R_1; Cu_1 and Cu_2) appear both convex on one impression (and, of course, concave on the duplicate impression), depending on the manner of splitting of the block, so that quite a false idea may be gained by following apparent convexity in fixing the name of a particular vein.

Unless otherwise stated, broken lines on the figures refer to missing parts reconstructed without concrete evidence.

Order Hemiptera.

All Permian Hemiptera are referable to the Sub-Order Homoptera. Tillyard (1935, p. 266) states that in all Permian Hemiptera (except the very characteristic Prosbolidae) the radial sector is simple, in all Copeognatha it is forked. This generalization has been controverted by a small Homopterous wing in the present collection, not of the Prosbolid type, with the sector clearly forked. On first examination of the collection it was considered possible that a plexus of Psocoid and Psylloid forms might exist, but this idea has been temporarily abandoned for want of further evidence. Other possibilities covering exceptions to Tillyard's generalization are: (1) That some Homoptera may have gained an additional branch of the radial sector by direct addition or else by capture from the media, or may have retained the forked condition from larger ancestors with fuller venation; or (2) that some Copeognatha may have lost a branch of the radial sector, by direct loss or capture by the media. The first course is shown to have occurred, the examples being discussed under the particular specimens; the second possibility should be borne in mind in evaluating problematical wings discovered in future.*

Division Auchenorrhyncha.

Tillyard (1926, p. 5) distinguishes this series from the Sternorrhyncha as follows:

Very small wings (less than 6 mm. long) with reduced, narrow clavus, the anal veins usually absent, rarely one or both present ..... Division Sternorrhyncha

Small to large wings (5 mm. up to 25 mm.) with a broad, well-developed clavus carrying two strong convex anal veins ..... Division Auchenorrhyncha

* The genera *Austropsocidium*, *Stenopsocidium* and *Zygopsocus*, described by Tillyard (1935) as Copeognatha, require re-examination in this light. The first two, except for the forked radial sector, have definite affinities to known Permian wings classed as Hemiptera. In Tillyard's figure of *Zygopsocus* (op. cit., Fig. 5), the veins labelled R_{2+3}, R_4, M_{1+2} and M_{3+4} seem likely to represent R_3, M_{1+2}, Cu_{1a} and Cu_{1b} respectively, and the pair classed as R_5 to represent M_3 and M_4; under this interpretation, the wing becomes definitely Hemipterous, but the stem of M has been captured from the common stem (M + Cu) by R_5. Difficulty in deciding the ordinal placing of Permian wings is taken as evidence of the close community between Hemiptera and Copeognatha at that time-level, but a general discussion of these implications is outside the scope of the present report, and would go beyond the evidence offered by the collection under review.

It is clear from study of the present collection that the above distinctions do not hold. For instance, one tegmen of definite Scytinopterid facies is described below in the Auchenorrhyncha, although its length is only 3·9 mm.; the clavus of this specimen is not preserved. Again, more than half of the definitely Psylloid specimens studied have a well-developed clavus with two strong anal veins. The clavus is the part of a wing least likely to be preserved *in situ*, and it is probable that its apparent absence or weakness in the Sternorrhyncha studied by Tillyard (1926) is a feature of incomplete preservation rather than structural difference. In general, it seems likely that the two Divisions (Sternorrhyncha, Auchenorrhyncha) were not fully differentiated nor divided by a clear-cut line in the Permian.* There is no proof, moreover, that Permian wings at present assigned to the Sternorrhyncha belonged to insects with the peculiar origin of the mouth-parts characteristic of recent members of that Division.

Family Scytinopteridae.

Genus Psocoscytina, n.g.

Genotype: *Psocoscytina bifida*, n. sp.

Homoptera from the Upper Permian of New South Wales, the forewing strongly tegminized and of the general facies of *Orthoscytina* Till., but less than 4 mm. long. Sc short, weak, parallel to base of R_1; R_{1a} abruptly upcurved to costa, several obscure veinlets in pterostigmatic area between R_{1a} and R_{1b}. R_s arising just before half the wing-length, distally clearly forked; M and Cu_1 arising together from near base of R_1, and separating at about one-eighth the wing-length from their origin; M sending a strong cross-vein (r-m) to R_s at two-thirds the wing-length; M forked just beyond r-m to an anterior branch (M_{1+2}) and a posterior branch which again forks (M_3, M_4). Cu_1 once forked, the anterior branch (Cu_{1a}) arched; Cu_2 connected to common base of R, M and Cu_1 by a weak oblique vein. Details of clavus not preserved. Hindwing unknown.

The genus is distinguished from all Scytinopteridae by the forking of R_s. The general facies, and details of R_1, agree with *Orthoscytina* Tillyard (1926); Sc agrees with *O. irregularis* Tillyard (op. cit., Fig. 8), M with *O. indistincta* Tillyard (op. cit., Fig. 6), which, however, lacks the cross-vein r-m. Cu_1 is usually three-branched in *Orthoscytina*, but otherwise there is considerable similarity. The inter-cubital cross-vein of *Psocoscytina* is weaker than in *Orthoscytina* and more basal in position.

Psocoscytina bifida, n. sp. (Fig. 1.)

Holotype tegmen: Aust. Mus. No. F 39790; obverse: Aust. Mus. No. F 39791. Length 3·9 mm.; maximum breadth 39% of the length. Venation: See figure and generic description.

The type and obverse are brown, and rather heavily carbonized, indicating complete tegminization. The extremity of M_3, missing on the type, is reconstructed in Fig. 1 from the obverse; the latter lacks details of the pterostigma.

Genus Anomaloscytina, n.g.

Genotype: *Anomaloscytina metapteryx*, n. sp.

Moderately large Auchenorrhyncha from the Upper Permian of New South Wales, the forewing unknown, the hindwing considerably modified for folding. Sc short but distinct; R_1 with an apparent articulation at half the wing-length, where R_s originates from it. R_{1a} at right-angles to R_1, weak; area between R_{1a} and R_{1b}, which continues the course of R_1 to the wing-tip, carbonized. R_s simple, with a pigment-band, probably trace of a cross-vein, connecting to R_{1b}. Media two-branched, base lost, probably in adaptation to folding (cf. weakening of the recurrent vein, M, in Coleoptera Polyphaga); fork of M connected by a pigment-band (trace of a cross-vein) to Cu_{1a}; M_{1+2} similarly connected to R_s. Cu_1 arising from base of R, forked at two-thirds its length. Cu_2 (*vena dividens*)

* A somewhat similar course is adopted by Carpenter, who (1931) refers all Kansas Lower Permian Homoptera to an intermediate and extinct Division, Paleorrhyncha, and (1939) refers *Permopsylla* to the Archescytinidae. Tillyard's acceptance of the Auchenorrhyncha and Sternorrhyncha is followed with reservations in the present paper, in order to facilitate comparison between new genera and those described by him from the Upper Permian of New South Wales.

connected by one oblique vein to base of Cu_1, by another to base of 1A. 1A and 2A simple, almost straight; trace of a third anal vein present.

This genus does not agree with any known hindwing. It may later be assigned to an existing genus now known from the forewing alone (e.g., *Homaloscytina* Tillyard, 1926). It shows some slight similarity to hindwings of the Triassic family Mesogereonidae Till.

ANOMALOSCYTINA METAPTERYX, n.sp. (Fig. 2.)

Holotype hindwing: Aust. Mus. No. F 39792. Length 7·3 mm.; maximum breadth 56% of the length. Venation: See figure and generic description.

Genus EOCHILIOCYCLA, n.g.

Genotype: *Eochiliocycla angusta*, n. sp.

Rather small Auchenorrhyncha from the Upper Permian of New South Wales, the forewing narrow, Sc weak, parallel to base of R; R_1 straight, ending at a re-entrant angle on the costal margin at half the wing-length, with a weak posterior branch (R_{1b}) and pterostigma. R_s simple, arising as posterior branch of R_1 just before the fork of the latter and running almost to the wing-tip. M simple, arising near base of R, ending near wing-tip, and connected to R_s by two cross-veins, one near base of R_s, the other just beyond half-way from the first to the margin; between these a cross-vein (ir) runs up to R_{1b}. Cu_1 arising separately from R and M, connected by a cross-vein to M near base, distally forked, the anterior branch (Cu_{1a}) continuing the course of the stem, the posterior (Cu_{1b}) markedly sigmoidally curved. Cu_2 almost straight, arising with Cu_1, distally connected to Cu_{1b} by a cross-vein (icu). Three strong anal veins present, arising together but separately from the cubitals, and distally confluent. Hindwing unknown.

This genus is very distinct from known Permian Homoptera, but may be compared with *Chiliocycla* Tillyard (1922*b*, Fig. 79), from the Triassic of Queensland. Both seem rather unlike other Scytinopteridae, but, as Tillyard has allowed *Chiliocycla* as belonging to this family, this classification may be retained temporarily. *Chiliocycla* has a well-developed subcosta and a thickened costal margin. Assuming the veins in *Chiliocycla*

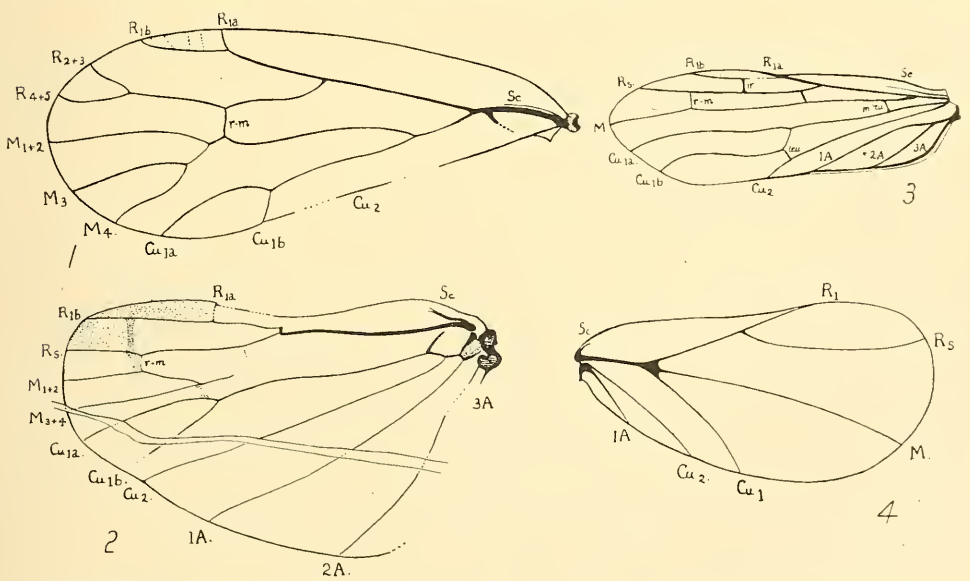

Fig. 1.—*Psocoscytina bifida*, n.g. et sp., holotype tegmen (Aust. Mus. No. F 39790), × 18. (Extremity of M_3 and margin adjacent restored from obverse; clavus missing.) Fig. 2.—*Anomaloscytina metapteryx*, n.g. et sp., holotype hindwing (Aust. Mus. No. F 39792), × 8. (Fracture of block indicated.) Fig. 3.—*Eochiliocycla angusta*, n.g. et sp., holotype tegmen (Aust. Mus. No. F 39793), × 8. Fig. 4.—*Eupincombea postica*, n.g. et sp., holotype hindwing (Aust. Mus. No. F 39794), × 18.

labelled by Tillyard (l.c.) as R_{2+3} and R_{4+5} are really R_1 and R_s, the radius and its sector of *Eochiliocycla* differ only in the position of their terminations with respect to the costa. The media of *Eochiliocycla* is simple (three-branched in *Chiliocycla*, with a cross-vein, im, forming a median cell). The cubitals agree except for the orientation of the cross-vein m-cu; the anal region of *Chiliocycla* is not preserved. The punctate sculpture of *Chiliocycla scolopoides* is absent from *Eochiliocycla*.

Eochiliocycla angusta, n. sp. (Fig. 3.)

Holotype tegmen: Aust. Mus. No. F 39793. Length 5·7 mm.; maximum breadth 34% of the length. Venation: See figure and generic description. Carbonization of membrane not marked; veins thick and heavily carbonized.

Division Sternorrhyncha.

Family Pincombeidae.

Genus Eupincombea, n.g.

Genotype: *Eupincombea postica*, n. sp.

Very small Homoptera from the Upper Permian of New South Wales; the forewing unknown, the hindwing broadly ovate; Sc short, near costa; R strongly upcurved beyond common origin of M and Cu_1, then continuing straight to a simple termination on the costa (R_1) at about two-thirds of the wing-length. R_s simple, slightly concave to the costal margin, arising from R_1 just beyond half-way between origin of M and end of R_1. M simple; Cu_1 simple, arising from R at same point as M before one-quarter of the wing-length. Cu_2 thin but distinct, arising separately from R; a single anal present, straight and well developed.

Although definitely Sternorrhynchous, it is not possible to assign this hindwing to any genus named from the forewing alone. It is provisionally referred to the family Pincombeidae; it agrees with the forewing of *Pincombea mirabilis* Tillyard (1922*a*, Fig. 2) in the simplicity of R_1 and the method of origin of M and Cu_1, but there is no reason to suppose that these features in a hindwing are necessarily associated with similar details in the forewing.

Eupincombea postica, n. sp. (Fig. 4.)

Holotype hindwing: Aust. Mus. No. F 39794. Length 2·6 mm.; maximum breadth 50% of the length. Venation: See figure and generic description. Whole wing membraneous, veins distinct.

Family Permopsyllidae.

Genus Eopsyllidium, n.g.

Genotype: *Eopsyllidium delicatulum*, n. sp.

Very small Homoptera from the Upper Permian of New South Wales, the forewing without apparent subcosta, the base of R strongly arched before the origin of M; R_{1b} continuing the course of R_1, pterostigma well developed and crossed basally by R_{1a}, which is rather indistinct. R_s simple, arising from R_1 about half-way between origin of M and termination of R_{1b}; M arising from R at a little under one-quarter the wing-length, forked at its middle to an anterior branch (M_{1+2}), which gives a strong cross-vein (r-m) to the base of R_s, and a posterior branch (M_{3+4}). Cu_1 arising separately from R, forked, anterior branch (Cu_{1a}) arched, posterior (Cu_{1b}) descending, sinuous. Cu_2 thin, slightly convex to costal margin, and separating off a broad clavus with a single straight anal vein (1A), which is connected to the base of Cu_2 by an oblique vein. Hindwing unknown.

This genus differs from all others in the family in the separate origin of Cu_1 there does not even seem to be any cross-vein (m-cu) connecting M and Cu_1, although this area is slightly crumpled in the unique type, and undulations in the surface of the block can be seen. In other respects it does not lie very close to described genera of Permopsyllidae (cf. Tillyard, 1926, p. 26, Key), in which family, however, it is provisionally placed.

Eopsyllidium delicatulum, n. sp. (Fig. 5.)

Holotype forewing: Aust. Mus. No. F 39795. Length 2·8 mm.; maximum breadth 49% of the length. Venation: See figure and generic description. Whole wing membraneous, veins distinct.

Note.—It cannot be decided with absolute certainty that this specimen is not a hindwing.

Genus Psocopsyllidium, n.g.

Genotype: *Psocopsyllidium media*,* n. sp.

Homoptera from the Upper Permian of New South Wales, large for the Division Sternorrhyncha, the forewing apparently without subcosta, the termination of R_1 missing, R_s arising from R at about one-half the wing-length, simple, terminally downcurved; M and Cu_1 arising together from R at about one-quarter the wing-length; M forked not far from its separation from Cu_1, the posterior branch (M_{3+4}) simple, the anterior branch forked again to M_1 (which is connected by a strong oblique cross-vein, r-m, to R_s) and M_2. Cu_1 separating from common stem with M not far from its base, once forked, the anterior branch (Cu_{1a}) arched. Cu_2 and 1A arising together, at first diverging, then running parallel, and terminally converging again; Cu_2 connected to common base of R, M, and Cu_1 by an oblique vein. Trace of a second anal vein present, very short. Hindwing unknown.

This genus differs from *Permopsyllidium* Tillyard (1926, p. 27) in the down-curved end of R_s and in the position of r-m, which in *Permopsyllidium* connects to M_{1+2} before the latter forks. It differs from *Permothea* Tillyard (1926, p. 28) in the apparent absence of a subcosta (not an important point in all probability), in the origin of r-m (arising at the fork of M_{1+2} in *Permothea*), and in the disposition of the branches of M. From both these genera it differs in the more distal placing of the common stem of M and Cu_1. The strong oblique cross-vein r-m, connecting R_s with M, indicates how capture of M_1 by R_s might give a Psocoid appearance to a Psylloid wing; this process is here incomplete,† but if the base of M_1 assumed the appearance of a cross-vein it would then

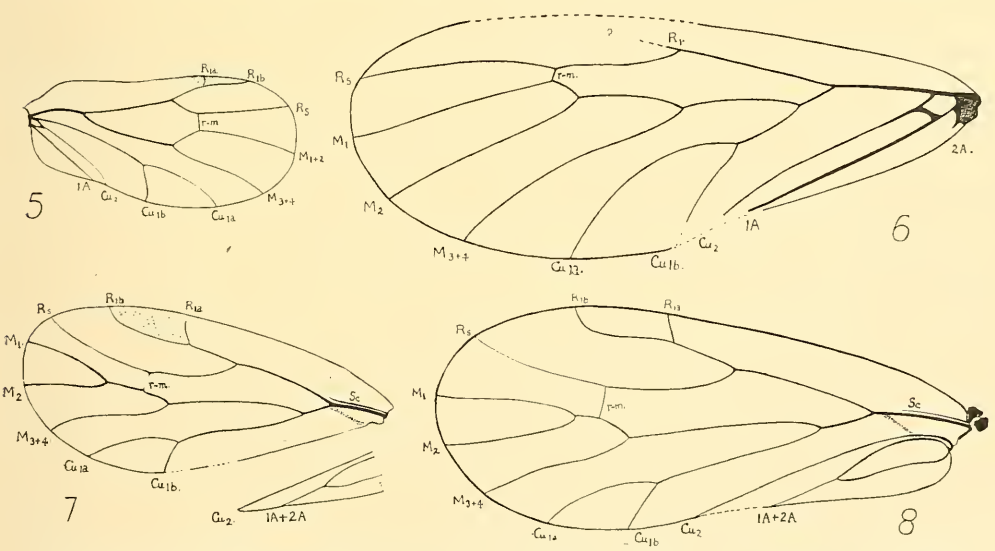

Fig. 5.—*Eopsyllidium delicatulum*, n.g. et sp., holotype forewing (Aust. Mus. No. F 39795), × 13. Fig. 6.—*Psocopsyllidium media*, n.g. et sp., holotype forewing (Aust. Mus. No. F 39796), × 18. (Pterostigmatic area missing.) Fig. 7.—*Permotheëlla scytinopteroides*, n.g. et sp., holotype forewing (Aust. Mus. No. F 39797), × 13. (Clavus displaced as in specimen; dotted line near Sc probably not a true vein). Fig. 8.—*P. scytinopteroides*, n.g. et sp., forewing (Aust. Mus. No. F 39798), × 18.

* The specific name is proposed as a noun in apposition, referring to the vein of that name. It is not to be changed by later workers for supposed adjectival agreement.

† Cf. also Carpenter, 1939, Figs. 15, 16 (*Archescytina* spp.).

be classed, on first inspection, as r-m, the radial sector thus gaining a forked appearance and the media appearing only two-branched.

Psocopsyllidium media, n. sp. (Fig. 6.)

Holotype forewing: Aust. Mus. No. F 39796. Length 4·6 mm.; maximum breadth 39% of the length. Venation: See figure and generic description. Impression only very slightly carbonized.

Genus Permotheëlla, n.g.

Genotype: *Permotheëlla scytinopteroides*, n. sp.

Rather small Homoptera from the Upper Permian of New South Wales, the forewing strongly tegminized, Sc short and faint, parallel to base of R; pterostigma, between R_{1a}, R_{1b} and costal margin, well developed; R_s arising from R before half the wing-length, simple, upcurved terminally. M and Cu_1 arising together from R at about one-sixth the wing-length, M forking a little beyond half the wing-length, its anterior branch (M_{1+2}) sending a cross-vein (r-m) to R_s, and beyond this forking to M_1 and M_2. Posterior branch of M (M_{3+4}) simple, sinuous. Cu_1 separating from common stem with M, whose length is about one-tenth that of the wing, and distally forked, its anterior branch (Cu_{1a}) arched; a faint intercubital vein present near base of common stem of M and Cu_1. Cu_2 separating off a distinct clavus, which carries two strong anal veins, diverging basally from a common source and distally coalescing to run together for nearly half their length. Hindwing unknown.

This genus differs from *Permopsylla* Till. (Lower Permian of Kansas; cf. Tillyard, 1926, Fig. 23) in the form of Sc, and the length of the common stem of M and Cu_1. Among New South Wales Permian Homoptera it stands closest to *Permothea* Tillyard (1926, p. 28, and Fig. 27), but differs from it completely in the position and shape of the pterostigma, Sc, r-m, M_1 and M_2, and in the origin of the inter-cubital vein from the base of Cu_1. Details of the clavus of *Permopsylla* and *Permothea* are not known.

Permotheëlla scytinopteroides, n. sp. (Figs. 7–8.)

Holotype forewing: Aust. Mus. No. F 39797; Fig. 7, clavus disconnected from rest of wing. Length 3·8 mm.; maximum breadth 44% of the length. Venation: See figure and generic description. Whole wing heavily carbonized, minutely punctate, somewhat crumpled, with irregularities in the block below and parallel to the distal half of R_s, and between the cubitals at about half-way between the origin of Cu_1 and its fork. A faint oblique line runs up from Sc to the costa near the base; this is probably not a vein but merely an irregularity in the block.

A second forewing (Aust. Mus. No. F 39798; Fig. 8) has the clavus in position, but the venation in the distal third is very faint; the wing is only very slightly carbonized. The disposition of the veins agrees with the type. Length 4·0 mm.; maximum breadth 42% of the length.

Genus Permopsyllidops, n.g.

Genotype: *Permopsyllidops stanleyi*, n. sp.

Rather small Homoptera from the Upper Permian of New South Wales, the forewing apparently without Sc; R_s given off from R_1 at about one-third the wing-length, terminating (as R_{1b}) at two-thirds the wing-length; R_{1a} given off abruptly nearer to origin of R_s than to end of R_{1b}. R_s simple, bent down in middle to give off a cross-vein r-m. M and Cu_1 arising by a common stem from the extreme base of R_1, and separating from each other at one-sixth the wing-length from common origin; a weaker oblique vein runs up and back from their point of separation, to meet R_1 at one-seventh the wing-length from the base; this probably represents the original common stem of M and Cu_1, their apparent origin (vein to wing base) being an over-developed inter-cubital which has captured them. M forked just before the cross-vein r-m, the anterior branch forked again beyond r-m to M_1 and M_2. Posterior branch of M (M_{3+4}) simple. Cu_1 forked, anterior branch (Cu_{1a}) arched. Cu_2 absent (a faint line near the base may indicate its position). A single short downwardly-directed anal present. Hindwing unknown.

This genus differs from other Permian Psylloids in the details of separation of the common stem of M and Cu_1 from R. In other respects it stands rather close to *Permopsyllidium* Tillyard (1926, l.c.), which, however, has Cu_2 well developed and the angle between R_{1a} and R_{1b} acute.

PERMOPSYLLIDOPS STANLEYI, n. sp. (Fig. 9.)

Holotype forewing: Aust. Mus. No. F 39799. Length 3·0 mm.; maximum breadth 45% of the length. Venation: See figure and generic description. Impression somewhat carbonized.

Genus CLAVOPSYLLIDIUM, n.g.

Genotype: *Clavopsyllidium minutum*, n. sp.

Very small Homoptera from the Upper Permian of New South Wales, the forewing without apparent subcosta, R_s arising from R at one-third the wing-length; R_1 continued as R_{1b}, concave to costa, with R_{1a} given off sharply as a pigment-bordered veinlet nearer to end of R_{1b} than to origin of R_s. R_s simple, sinuous; no radio-median cross-vein. Common stem of M and Cu_1 arising from R half-way between base and origin of R_s, forking almost beneath origin of R_s to M and Cu_1; M forked at about half its length, its anterior branch (M_{1+2}) again forked, its posterior branch (M_{3+4}) simple. Cu_1 forked, anterior branch (Cu_{1a}) arched, and ending closer to posterior branch (Cu_{1b}) than in most genera. Cu_2 straight, thin, origin independent from Cu_1; a broad, well-marked clavus present, with two anal veins arising basally from a common origin, diverging, and fusing again terminally. Hindwing unknown.

This genus stands closest to *Protopsyllidium* Till. (*infra*), from which it differs in the three-branched media and the shape of the cubital fork; and to *Permopsyllidium* Tillyard (1926, l.c.), from which it differs in the shape of R_s and the lack of r-m. The clavus of *Permopsyllidium* is not known. *Clavopsyllidium* is also somewhat similar to *Permotheëlla*, n.g., but is much smaller, and lacks Sc, r-m, and the fused portion of the anal veins.

CLAVOPSYLLIDIUM MINUTUM, n. sp. (Fig. 10.)

Holotype forewing: Aust. Mus. No. F 39800. Length 2·4 mm.; maximum breadth 47% of the length. Venation: See figure and generic description. Wing membraneous, not carbonized.

Genus PROTOPSYLLIDIUM Tillyard 1926.

PROC. LINN. SOC. N.S.W., 51, p. 26. Genotype: *Protopsyllidium australe* Tillyard, 1926, l.c.

PROTOPSYLLIDIUM SINUATUM, n. sp. (Figs. 11–15.)

Tillyard's type specimen of the genotype is not available,* so that comparison can be made only with his published figure (op. cit., Fig. 24). On this basis, the present species is described as new; it is represented by six specimens and one duplicate impression, all of which agree in general structure and differ from the figure of *P. australe*.

In *P. sinuatum* the pterostigma is well developed, R_{1a} being represented by a broad pigment-band, the distal border of which is sometimes developed as a definite veinlet. The second cubitus shows a very weak subterminal anterior branch, an unusual feature; this is better shown on specimens other than the holotype. The clavus (not preserved in the type of *P. australe*) shows two strong anal veins, disposed as in *Clavopsyllidium minutum* (*supra*). The wing outline is regularly obovate in *P. australe*, but in all specimens of *P. sinuatum* the bases of both costal and anal margins are definitely sinuous. In other respects *P. sinuatum* agrees with the genotype. The specimens show slight differences *inter se*, which can be evaluated from the figures; probably too little allowance for individual variation and variation in the state of preservation has been made in the

* The same applies to the types of others of Tillyard's species discussed in this paper. Lack of types is probably less serious here than in most cases, as the published camera lucida figures of outlines and venation convey nearly as much as the actual specimens. Nevertheless, identifications of specimens under existing species, and comparison of new species with species previously described, is subject to confirmation by later re-examination of the types.

past in fixing interspecific differences, and it is indeed possible that longer series might lead to the rejection of the name *P. sinuatum* as a synonym of the genotype.

The following specimens are represented:

Holotype forewing: Aust. Mus. No. F 39801; Fig. 11; and obverse: Aust. Mus. No. F 39802. Length 2·7 mm.; maximum breadth 43% of the length. Membraneous.

Forewing: Aust. Mus. No. F 39803; Fig. 12. Length 3·1 mm.; maximum breadth 43% of the length. Faintly carbonized.

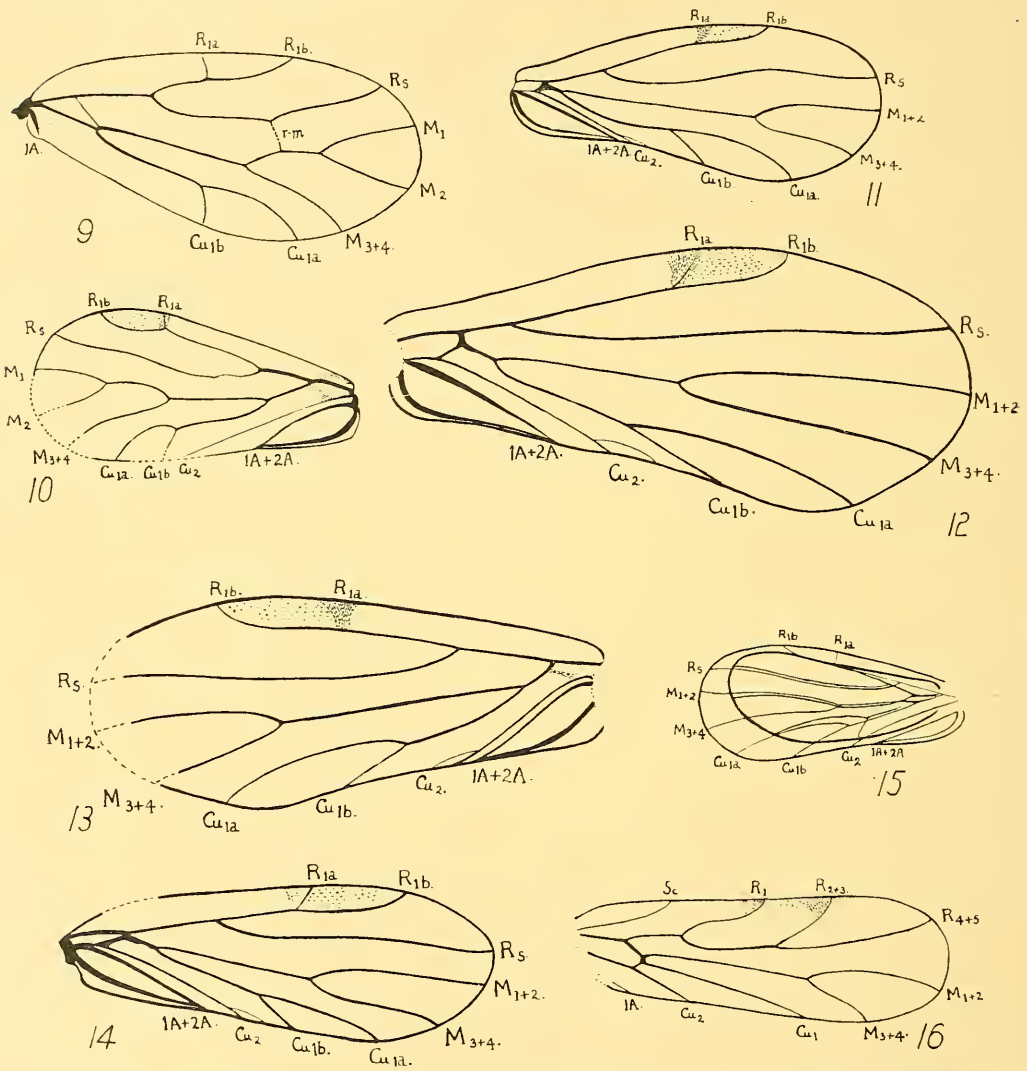

Fig. 9.—*Permopsyllidops stanleyi*, n.g. et sp., holotype forewing (Aust. Mus. No. F 39799). × 18. (Broken line between Cu_1 and 1A represents obsolescent Cu_2, a barely-discernible groove on the block.) Fig. 10.—*Clavopsyllidium minutum*, n.g. et sp., holotype forewing (Aust. Mus. No. F 39800), × 18. (Carbonization in intercubital and subcostal regions, as indicated by stippling, not accompanied by apparent veins.) Figs. 11-15.—*Protopsyllidium sinuatum*, n. sp. 11. Holotype forewing (Aust. Mus. No. F 39801), × 18. 12. Forewing (Aust. Mus. No. F 39803), × 25. 13. Forewing ($\frac{CD}{13}$; Mr. Malcolm Stanley's Collection), × 21. 14. Forewing ($\frac{CD}{14}$; Mr. Malcolm Stanley's Collection), × 21. 15. Forewing overlapping hindwing (Aust. Mus. No. F 39804), × 9. (Apparent structure.) Fig. 16.—*Zoropsocus stanleyi*, n. sp., holotype forewing (Aust. Mus. No. F 39805), × 29.

Forewing ($\frac{CD}{13}$; Fig. 13, Mr. Malcolm Stanley's Collection). Length 3·5 mm.; maximum breadth 40% of the length. Faintly carbonized.

Forewing ($\frac{CD}{14}$; Fig. 14, Mr. Malcolm Stanley's Collection). Length 2·9 mm.; maximum breadth 36% of the length. Faintly carbonized.

Forewings (2), hindwing (venation not discernible) and tip of abdomen ($\frac{CD}{15}$; not figured, Mr. Malcolm Stanley's Collection). Length of forewing 2·0 mm.; maximum breadth 39% of the length; scarcely carbonized. Hindwing 1·4 mm. × 0·5 mm.

Forewing completely overlapping hindwing: Aust. Mus. No. F 39804; Fig. 15. Length of forewing 3·7 mm.; maximum breadth 45% of the length. Hindwing 3·2 mm. × 1·3 mm.; R_1 apparently simple, M as in forewing, fork of Cu_1 wider than in forewing.

Order Copeognatha.

Family Zoropsocidae.

Genus Zoropsocus Tillyard 1935.

Proc. Linn. Soc. N.S.W., 60, p. 273. Genotype: *Zoropsocus delicatulus* Tillyard 1935, loc. cit.

Zoropsocus stanleyi, n. sp. (Fig. 16.)

This species differs from the figure of the type specimen of *Z. delicatulus* (Tillyard, 1935, Fig. 6) in that M and Cu_1 definitely arise from a short common stem (separate parallel origin in *Z. delicatulus*). It also differs in the disposition of the terminations of M_{1+2} and M_{3+4}, which are down-curved in the present species. In other respects, except the size, which is considerably less, it agrees with the figure of the type of *Z. delicatulus*.

Holotype forewing: Aust. Mus. No. F 39805; Fig. 16. Length 1·8 mm.; maximum breadth 33% of the length.

Another wing, in the collection of Mr. Stanley, agrees exactly in its venation. It is even smaller (1·5 mm. × 0·5 mm.) and is rather strongly carbonized.

Family Lophioneuridae.

Genus Lophiocypha Tillyard 1935.

Proc. Linn. Soc. N.S.W., 60, p. 274. Genotype: *Lophiocypha permiana* Tillyard 1935, op. cit., p. 275.

Lophiocypha permiana Tillyard 1935, l.c. (Fig. 17.)

Figure 17 is a camera lucida outline of a specimen in the collection of Mr. Malcolm Stanley, identified by the late Dr. R. J. Tillyard as *L. permiana*. It agrees with the figure of the type (Tillyard, 1935, Fig. 7A) except in the longer clavus, the more distal position of the inter-cubital cross-vein, the more sinous course of R_{4+5}, and the more distal termination of R_1, all of which Tillyard rightly regarded as intraspecific variations.

The dimensions are: Forewing, length 2·8 mm.; maximum breadth 36% of the length; length of body behind articulation of forewing, 1·9 mm.

Lophiocypha stanleyi Tillyard 1935. (Figs. 18–22.)

Op. cit., p. 276, Fig. 8.

Five specimens in the collection under review are referred to this species. In all cases R_1 ends beyond half-way along the wing and the subcosta is, if apparent, short (cf. specific key, Tillyard, 1935, p. 275). It seems possible that this species may later be synonymized with the genotype, *L. permiana* Till., as data referring to the subcosta are doubtful and subject to individual variation and to differences in the state of preservation, while the specimen noted above under *L. permiana*, and identified by Tillyard as such (Fig. 17), has R_1 ending beyond half the wing-length.

The following specimens have been examined:

(1) Forewing partly overlapping hindwing: Aust. Mus. No. F 39806; Fig. 18. Length of forewing 2·9 mm.; maximum breadth 36% of the length; venation typical for

L. stanleyi, but the clavus is folded forwards over the wing base. Hindwing 1·9 mm. × 0·6 mm., R_1 almost straight, ending at half the wing-length; R_s with a wide distal fork; M simple, sinuous.

(2) Forewing with costal half overlapping most of hindwing: Aust. Mus. No. F 39807; Fig. 19. Length of forewing 3·0 mm.; maximum breadth 31% of the length; venation as in the figure of the type, except that 1A is longer, a short second anal (2A) is present,

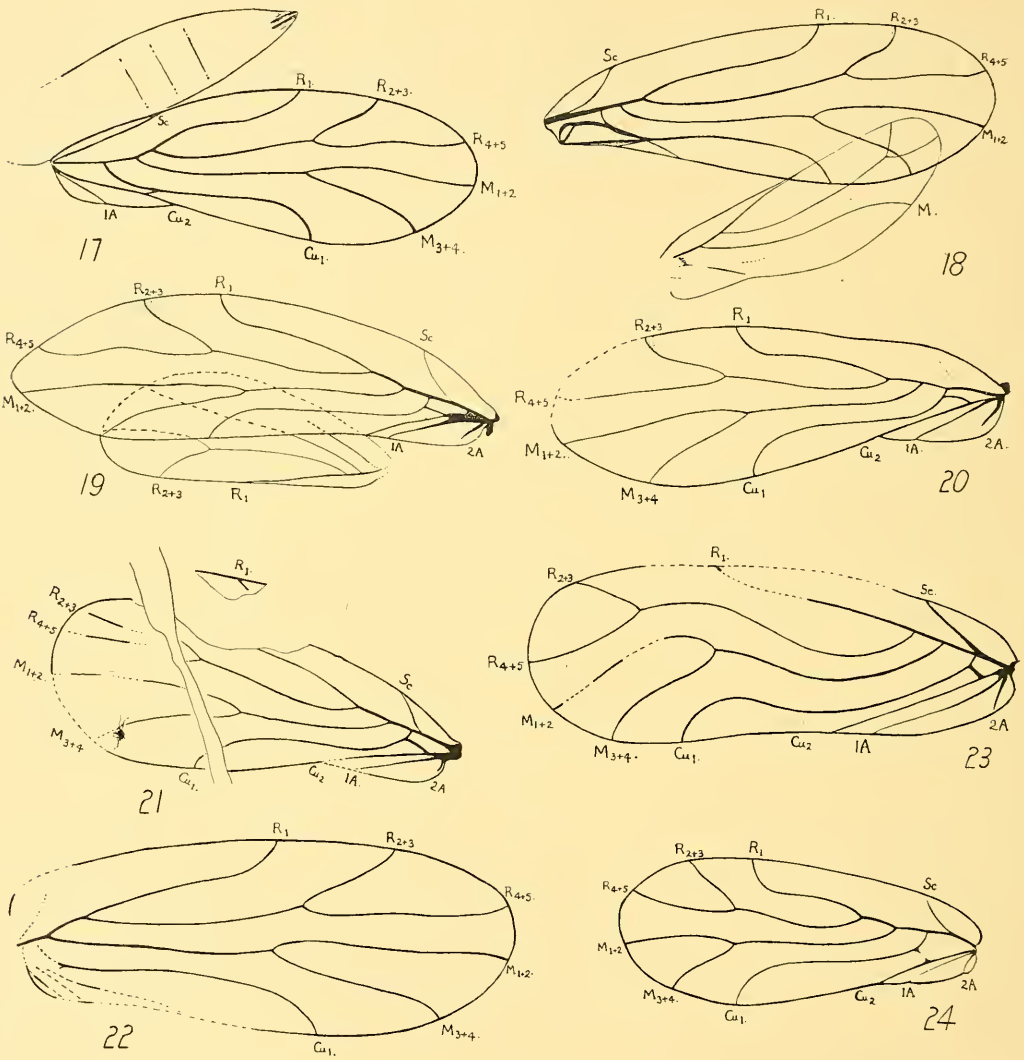

Fig. 17.—*Lophiocypha permiana* Till., forewing, and body behind its attachment, × 21. Figs. 18-22.—*Lophiocypha stanleyi* Till. 18. Fore- and hindwing (Aust. Mus. No. F 39806), × 21. (Broken lines of hindwing refer to structures faintly visible on the block.) 19. Fore- and hindwing (Aust. Mus. No. F 39807), × 21. (Broken lines as in Fig. 18.) 20. Forewing ($\frac{CD}{20}$; Mr. Malcolm Stanley's Collection), × 21. 21. Damaged forewing ($\frac{CD}{21}$; Mr. Malcolm Stanley's Collection), × 21. 22. Forewing ($\frac{CD}{22}$; Mr. Malcolm Stanley's Collection), × 21. (Base damaged, costal portion shifted proximad, claval portion distad.) Fig. 23.—*Lophiocypha maxima*, n. sp., holotype forewing (Aust. Mus. No. F 39808), × 15. Fig. 24.—*Austrocypha abrupta* Till., forewing (reconstructed from two slightly-damaged forewings on specimen Aust. Mus. No. F 39809), × 21.

and the whole wing outline is somewhat distorted by crumpling. Hindwing 1·9 mm. × 0·7 mm., venation as above.

(3) Forewing ($\frac{CD}{20}$; Fig. 20, Mr. Malcolm Stanley's Collection). Length 2·9 mm.; maximum breadth 34% of the length. Venation as in the preceding specimen, except that details of the subcosta are not apparent, although this part of the wing is preserved fairly well. A poorly-preserved body (length 1·7 mm.) lies beside the wing on the block.

(4) Forewing ($\frac{CD}{21}$; Fig. 21, Mr. Malcolm Stanley's Collection). Length 2·7 mm. (estimated); maximum breadth approximately 38% of the length. Venation as in (2).

(5) Forewing ($\frac{CD}{22}$; Fig. 22, Mr. Malcolm Stanley's Collection). Length 3·2 mm.; maximum breadth 39% of the length. Base damaged, the claval portion shifted distad and the costal portion proximad; details of subcosta and clavus obscure, venation otherwise as above.

LOPHIOCYPHA MAXIMA, n. sp. (Fig. 23.)

A single forewing, by far the largest of the genus, serves as holotype for this species. Details are as follows:

Holotype forewing: Aust. Mus. No. F 39808; Fig. 23. Length 4·5 mm., maximum breadth 35% of the length. Venation as in *L. stanleyi* Till., but with the bases of R_s and M strongly curved sigmoidally, and the two anals longer and more distinct. The curvature of R_s and M suggests the genus *Lophioneura* Tillyard (1921), which is stated to have no clavus or anal veins (although this may possibly be due to poor preservation), and which has Cu_1 forked. The distinction between these two genera may later be found to break down, but in any case the present specimen is specifically distinct.

Genus AUSTROCYPHA Tillyard 1935.

Op. cit., p. 277. Genotype, *Austrocypha abrupta* Tillyard 1935, p. 278.

This genus is allowed as distinct from *Cyphoneura* Carpenter (1932) on the factors of locality and horizon; the obsolescence of Sc, used by Tillyard (op. cit., p. 274, Key) as a distinguishing feature, does not seem to hold (cf. also Tillyard, 1935, Fig. 11), and the lack of an intercubital connection in *Cyphoneura* may be merely apparent; the vein icu is often difficult to make out, and may be subject to individual variation; it is very indistinct on the specimen (Aust. Mus. No. F 39809) discussed below. The more distal point of origin of R_s in these two genera, as compared to *Lophioneura* and *Lophiocypha*, is a rather slender generic criterion, which may later require review.

AUSTROCYPHA ABRUPTA Tillyard 1935, l.c. (Fig. 24.)

To this species is referred a specimen (Aust. Mus. No. F 39809) showing a slightly-telescoped body (length 2·1 mm.) and two forewings, both fairly well preserved, from which the following data and figure (Fig. 24) have been reconstructed:

Length 2·3 mm.; maximum breadth 41% of the wing-length. Venation as in the figure of the type (Tillyard, 1935, Fig. 10), except that Sc is definitely present and the fork of M is opposite that of R_s (cf. *Austrocypha barretti* Tillyard 1935, p. 278, and Fig. 11); the upcurved end of R_1 in the present specimen agrees with *A. abrupta* rather than *A. barretti*. The present specimen suggests strongly that *A. barretti* is a synonym of *A. abrupta*; the latter has page precedence. Careful study of the types, and of longer series, is necessary to establish this synonymy with certainty.

List of References.

CARPENTER, F. M., 1931.—The Lower Permian Insects of Kansas. Part 4. The Order Hemiptera, and Additions to the Palaeodictyoptera and Protohymenoptera. *Amer. J. Sci.*, (5) 22, 113-130.

————, 1932.—The Lower Permian Insects of Kansas. Part 5. Psocoptera and Additions to the Homoptera. Ibid., (5) 24, 1-22.

————, 1939.—The Lower Permian Insects of Kansas. Part 8. Additional Megasecoptera, Protodonata, Odonata, Homoptera, Psocoptera, Protelytroptera, Plectoptera and Protoperlaria. *Proc. Amer. Acad. Arts Sci.*, 73 (3), 29-70, pls. i-ii.

TILLYARD, R. J., 1921.—Two Fossil Insect Wings in the Collection of Mr. John Mitchell, from the Upper Permian of Newcastle, N.S.W., belonging to the Order Hemiptera. PROC. LINN. SOC. N.S.W., 46, 413-422, pl. xxxv.

————, 1922*a*.—Some New Permian Insects from Belmont, N.S.W., in the Collection of Mr. John Mitchell. Ibid., 47, 279-292, pls. xxxiii-xxxiv.

————, 1922*b*.—Mesozoic Insects of Queensland. Part ix. Ibid., 47, 447-470, pls. li-liii.

————, 1926.—Upper Permian Insects of New South Wales. Part i. Introduction and the Order Hemiptera. Ibid., 51, 1-30, pl. i.

————, 1935.—Upper Permian Insects of New South Wales. iii. The Order Copeognatha. Ibid., 60, 265-279.